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TECHNICAL NOTES

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 556

FURTHER MEASUREMENTS OF NORMAL ACCELERATIONS

ON RACING AIRPLANES

By N. F. Scudder and H. W. Kirschbaum
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SUMMARY

The work of collecting acceleration data for racing airplanes during races, started in January 1934, has been continued by obtaining similar data in the airplanes winning first and second places in the 1935 Thompson Trophy Race. Records were taken in the Howard Racer "Mr. Mulligan" and in the Wittman D-12 Racer. The maximum positive accelerations were generally smaller than those recorded in other airplanes during earlier races; the maximum in the Howard Racer was 2.8 g, and one value of 4.25 g was obtained in the Wittman Racer. Minimum values were as low as -0.55 g in the Howard Racer and 0.3 g in the Wittman Racer.

INTRODUCTION

More than a year ago the National Advisory Committee for Aeronautics began to collect acceleration data for racing airplanes during actual races. Data obtained in four well-known racing airplanes were published in August 1935 in reference 1. The present paper presents similar data for two more airplanes, the winners of first and second places in the Thompson Trophy Race of 1935 at the National Air Races in Cleveland.

The purpose of securing these acceleration records is, as explained in reference 1, to furnish data that will aid in making recommendations for increasing the structural safety of racing airplanes and that will indicate, as far as possible, methods of operating racing airplanes with less probability of subjecting them to extreme air loads. The use of indicating accelerometers by racing pilots so that they may train themselves to judge accelerations by "feel" is particularly emphasized.

APPARATUS AND METHOD

The airplanes in which the records reported herein were made were the Howard Racer "Mr. Mulligan" and the Wittman D-12 Racer.

The Howard Racer is a closed, high-wing monoplane powered with a 550-horsepower Wasp engine. The normal full-load weight is 4,210 pounds and the wing area through the fuselage 160 square feet, giving a wing loading of 26.3 pounds per square foot. The N.A.C.A. 2412 airfoil section is used. References 2 and 3 describe the airplane in detail.

The Wittman D-12 Racer, powered with a Curtiss D-12 engine, is similar in design features to the Wittman "Chief", for which acceleration records were reported in reference 1. The normal full-load weight is 2,100 pounds and the wing area (through the fuselage) 120 square feet, giving a wing loading of 17.5 pounds per square foot. The wing airfoil section is a modified M-10 section. It is slightly thicker than the M-10 section and the trailing edge is not reflexed quite so much.

The accelerometers were the same maximum recording accelerometers that were used in the tests reported in reference 1 and briefly described therein. The calibrations of these two instruments made before and after the tests agreed throughout the range of the accelerations recorded to within 0.01 g with the instrument used in the Howard Racer and to within 0.02 g with the one used in the Wittman Racer. The records may be considered dependable to $\pm 0.25g$.

The 1935 Thompson Race was 150 miles long, or 10 laps on a 15-mile course. The course had four turning points; two of them were close together on the airport, and the other two were located so as to mark three 5-mile legs of the course.

RESULTS AND DISCUSSION

The records were read at all the important maximums and minimums and are presented in the following table.

Airplane: Howard "Mr. Mulligan" Pilot: Harold Neuman Average speed: 220.2 m.p.h.		Airplane: Wittman D-12 Racer Pilot: S. J. Wittman Average speed: 218.7 m.p.h.	
Approximate time from start	Acceleration	Approximate time from start	Acceleration
Minutes	g	Minutes	g
0.5	2.20	0.5	4.25
.5	.10	.5	.35
2.5	2.80	1.5	3.15
4.5	2.47	2.5	3.50
5.0	2.62	2.5	.35
5.0	-.20	3.75	3.70
7.0	2.75	5.0	2.80
8.5	2.40	7.0	2.50
10.0	-.20	8.0	3.15
12.0	-.55	9.0	2.96
13.0	2.54	10.0	3.36
17.0	-.30	11.0	3.36
17.0	2.14	11.0	.35
20.0	-.30	12.0	3.15
21.0	2.47	13.0	3.50
22.0	2.40	15.0	3.72
22.0	-.20	16.0	2.96
25.0	-.20	17.0	2.72
27.0	2.62		
28.0	2.05		
29.0	2.05		
33.0	-.30		
34.0	2.40		
37.0	2.20		
		19.0	3.60
		19.0	.35
		20.0	3.15
		21.0	2.96
		22.0	2.96
		24.0	2.96
		26.0	2.96
		27.0	3.36
		27.0	.50
		28.0	2.72
		29.0	3.07
		30.0	.35
		30.5	3.36
		31.2	3.07
		31.2	.30
		33.0	3.36
		35.0	3.15
		37.0	2.65

The time of each reading was only a rough approximation because the time scale was rather close.

It was noted that the maximum values of accelerations recorded in the Howard Racer were generally 1.0 g lower than those recorded in the Wittman Racer. On the other hand, the minimum values reached in the Howard Racer were as low as -0.55 g, while those reached in the Wittman Racer were not less than 0.3 g. The differences in the maximum values may probably be attributed to differences in piloting; the differences in the minimum values might be caused by differences in airplane characteristics. The appearance of the actual record trace indicates that either the Wittman Racer rode the air bumps more smoothly or the instrument in this airplane was more nearly critically damped. The former point may be part of the reason for the difference in the records because it was observed during the race that the Wittman Racer appeared to "jump around" less than is usual for airplanes flying at the speed of the race. No definite conclusion, however, can be based on this one set of records.

CONCLUDING REMARKS

Inasmuch as there was no severe maneuvering at the pylons and the air was not rough, these records do not lead to any conclusions regarding maximum air loads and should be considered together with the records of reference 1. The present records show that care and skill on the part of the pilot are important factors in the determination of maximum air loads.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., January 30, 1936.

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2. Howard, Benjamin O.: Mister Mulligan. Aviation, October 1935, pp. 15-16.
3. Anon.: The Howard DGA6 - "Mr. Mulligan." Aero Digest, October 1935, pp. 80-81.